Trends of infection-related hospitalization rates in a large Canadian cohort of chronic dialysis patients accounting for dialysis-vintage

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Abstract

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Methods: Using provincial administrative databases, we built a retrospective cohort of all adult chronic dialysis patients (hemodialysis and peritoneal dialysis) between 2001 and 2007. We evaluated IRH rate trends according to dialysis vintage using stratification and standardization.

Results: 9822 patients (mean age=66.3±14.7 years, and 40% female) were followed for a median time of 2.1 (1.0-3.9) years. Between 2001 and 2007, IRH remained stable (0.20 to 0.19 /p-y; P=0.7). All-cause hospitalization rates decreased by 23% (1.53 to 1.18 /p-y; P<0.001) and cardiovascular admissions rates by 47% (0.45 to 0.24 /p-y; P<0.001). IRH remained stable throughout dialysis vintage ($P_{interaction}$=0.12). Both all-cause and cardiovascular hospitalizations rates decreased with time on dialysis ($P_{interaction}$<0.001). Standardization of hospitalization rates with age and sex, or dialysis vintage did not change interpretation of trends.

Interpretation: We found a decreasing trend of all-cause and cardiovascular hospitalization rates among patients on chronic dialysis, independently of age and sex, or dialysis vintage. Differently, trend of IRH remained stable, leading to an increase of the proportion of admissions related to infections. Hospitalizations are potentially preventable; therefore understanding epidemiology of IRH may inform future studies on prevention of this serious outcome.

Keywords: Renal Dialysis; Kidney Failure, Chronic; Epidemiology; Hospitalization; Infection; Cardiovascular diseases.

Introduction

End-stage renal disease (ESRD) is the last stage of kidney failure. ESRD is irreversible; to survive, patients with ESRD require a renal replacement therapy. The two modalities of renal replacement therapy are dialysis (including hemodialysis and peritoneal dialysis) and kidney transplantation. Chronic dialysis is associated with a high burden of morbidity requiring frequent and longer hospital admissions.[1,2] Studies conducted in the United States (US) reported high frequencies of infection-related hospitalizations (IRH) and associated morbidity and mortality in the dialysis population.[1,3-7] While rates of all-cause hospitalization remained fairly stable, rates of IRH among dialysis patients increased by 30.6% between 1994 and 2009 in the US.[1] These findings were at the origin of programs recognizing the need to decrease the use of hemodialysis tunnelled catheters, one of the main causes of infection in this population.[1,8] Similar studies have not been conducted in Canada. US estimates may not apply to the Canadian population because dialysis populations significantly differ between the two countries.[1,8] Among others, varying factors are: demographics (including age and race),[1,8,9] vascular access use,[10] and mortality rates.[1,8]

Patients initiating dialysis have a poor five-year survival rate of around 40%.[8] Because patients with major co-morbidities or older patients have a higher mortality rate, patients who survived a few years of dialysis (prevalent patients) greatly differ than patients initiating dialysis (incident patients). Therefore, one could hypothesize that hospitalization rates would decrease with time on dialysis. However, other factors come into play such as catheter removal, arising of cardiovascular and other complications (which would increase hospitalization rates), or kidney transplants. In brief, how IRH rates vary with dialysis vintage when all those factors are combined remains unpredictable and not well described. Because proportion of incident and

prevalent patients may change over time, reporting hospitalization rates without controlling for dialysis vintage may confound results. Until now, trends of IRH rates were usually reported for prevalent patients and not for incident patients. While the United-States Renal Data System (USRDS) annual report recently presented data on incident patients, only first-year hospitalization rates were reported.[1] Because IRH are potentially preventable, it is important to assess their frequency and associated risk factors to inform prevention strategies aiming to improve patient care.

The aim of this study was to describe population-based incidence rate trends from 2001 to 2007 of IRH among incident and prevalent dialysis patients, with a focus on dialysis vintage.

Methods

Study population and data sources

We obtained data from provincial health services administrative databases. Virtually all eight millions residents of Québec, Canada, are covered for their physician and hospital services by a universal single-payer health care system (*Régie de l'assurance maladie du Québec*, RAMQ). The RAMQ physician fee-for-service claims databases include all visits, diagnosis codes (*International Classification of Diseases, 9th Revision,* ICD-9) and procedures during in- or outpatient encounters. Primary diagnoses (coded by medical archivists using ICD-9 or ICD-10 after 2006) for each hospitalization was obtained from the hospital discharge summary database. Discharge summary data in Quebec have been validated for a number of conditions including hip fracture,[11] stroke,[12] myocardial infarction[13] and injuries.[14] For these conditions data accuracy was generally high.

Study cohort

We included in the study cohort all adult (≥18 years old) patients who were on chronic dialysis (hemodialysis or peritoneal dialysis) between January 1, 2001 and December 31, 2007. Both

incident (new patients initiating dialysis during the study period) and prevalent (patients already on dialysis at the beginning of the study) patients were included. While limiting the cohort to only incident patients would have resulted in a simpler cohort, including prevalent patients allowed having patients with different dialysis vintages starting in 2001, and therefore was essential to evaluate trends over the entire study period. We excluded patients who had less than 90 days of follow-up after chronic dialysis initiation, or had a prior kidney transplant. The 90-day criterion was used to ensure only maintenance dialysis patients were kept and to have a cohort comparable to other chronic dialysis cohorts. Patients were followed from January 1, 2001 or chronic dialysis initiation until death, kidney transplantation, or end of the study (December 31, 2007).

Admission categories

We identified all admissions during study follow-up. Hospitalizations at the time of dialysis initiation were excluded. Each admission was categorized using ICD-9 or -10 according to the primary diagnosis on the discharge sheet in three mutually exclusive categories: Infection, cardiovascular, or other cause (see Table S1 for specific codes). While the focus of this study was IRH, we included cardiovascular hospitalization because it is the principal cause of hospitalization in that population. Infections were further subdivided in dialysis-related infections, pneumonia, septicemia, and other infections (see Table S1).

Dialysis vintage

A dialysis vintage status was attributed to each patient for every calendar year. This variable was categorized according to the number of years the patient has been on dialysis: <1 year, ≥1 and <2 years, ≥2 and <3 years… If a patient initiated dialysis in the calendar year of interest, he was attributed the status <1 year. Since we had no access to data before January 1, 1999, patients with dialysis codes in January 1999 were assumed to have started dialysis in 1998 or before.

These patients were categorized as ≥3 years in 2001, ≥4 years in 2002, ≥5 years in 2003, *et cetera*.

Co-morbidities

Co-morbidities were assessed at the beginning of follow-up using ICD-9 codes in the two years prior to cohort entry, and included: cardiovascular disease, cerebrovascular disease, congestive heart failure, chronic pulmonary disease, diabetes, malignancy, and peripheral vascular disease (see Table S2 for specific codes).

Statistical analysis

Unadjusted admission rates were calculated by dividing the number of admissions by the total patient-years (p-y) of follow-up (number of days between dialysis initiation and end of follow-up summed over all study patients divided by 365.25 days). 95% confidence intervals (CI) for rates were calculated using a Poisson distribution. Linear trends were tested using the Mantel trend statistic.[15] Dialysis vintage-standardized rates were produced using the whole cohort person-time distribution, and using dialysis vintage strata (<1, 1, 2, ≥3 years) that were common throughout all calendar years. We also calculated age and sex standardized rates using the same reference population, and using four age strata (<55, 55-64, 65-74, ≥75). Because of a prohibitive increase in number of strata, we were not able to calculate adjusted rates for both dialysis vintage and demographics. However, statistical interaction between dialysis vintage and calendar time was evaluated by including a multiplicative term (calendar_year*dialysis_vintage) in a Poisson multivariate regression model. All analyses were done using SAS 9.2 (Cary, North Carolina).

Sensitivity analyses

To ensure robustness of hospitalization rates trends with dialysis vintage, we conduct a similar analysis but using survival-modeling techniques. To model and plot how instantaneous risk of

hospitalization varied with time from dialysis initiation (baseline hazard function), a counting-process Cox regression model for recurrent events with the Breslow estimator was used.[16] We also redid all analysis where we excluded patients initiating dialysis before January 1999, since their dialysis initiation date was unknown. Finally, we analyses were redone by dialysis modality.

Ethical considerations

This study was approved by Maisonneuve-Rosemont Hospital and Government of Québec (*Commission d'accès à l'information*) ethics committees, and informed consent was waived.

Results

We included 9822 patients in the cohort (Figure 1). Baseline characteristics are presented in Table 1. Mean age was 66.3 (±14.7) years, 40% were female, and 81% were on hemodialysis at 90 days of follow-up. Diabetes and cardiovascular disease were the most prevalent co-morbidities at 45% and 41%, respectively. Incident patients (n=6767) represented 69% of the whole cohort.

Patients were followed for a median time of 2.1 (interquartile range (IR): 1.0-3.9) years. During the entire follow-up, we identified 35 246 admissions. Recurrent admissions for a given patient were frequent: No admissions, 1181 patients (12%); one admission, 1923 patients (20%); two admissions, 1645 patients (17%); three or more admissions, 5073 patients (52%). The median length of stay was 4 days (IR: 1-12 days). Overall rates of admissions are given in Table 2. As expected, cardiovascular-related hospitalizations were the most frequent (0.354 /p-y), followed by IRH (0.200 /p-y). Among IRH, dialysis-related infections were the most frequent reason of hospitalization (0.046 /p-y).

Trends of rates by calendar time are shown on Table 3 and Figure 2. While between 2001 and 2007 all-cause hospitalization rates decreased by 23% (1.53 to 1.18 /p-y) (*P* trend <0.001) and cardiovascular admissions rates decreased by 47% (0.45 to 0.24 /p-y) (*P* trend <0.001), IRH

remained stable (*P* trend = 0.73). Therefore, the proportion of admissions related to infections increased from 13 to 16% of all admissions.

As shown on Figure 3, IRH remained fairly stable throughout dialysis vintage (*P* trend=0.12). Differently, all-cause and cardiovascular hospitalizations rates decreased with time on dialysis (*P* trend <0.001 for both). For both, most of the downward slope was in the first three years of dialysis initiation. Findings from these trends were also supported by the modeled baseline hazard function (Figure 4).

Interaction between calendar time and dialysis vintage was not statistically significant for IRH (*P*=0.85). However, this interaction was statistically significant for all-cause hospitalizations rates (*P*<0.001), meaning that hospitalization rate trends over calendar years varied with dialysis vintage categories. Interaction was significant for cardiovascular (*P*=0.04). However, dialysis vintage-standardized rates were highly similar to unadjusted rates (Table 3), signifying that this interaction did not influence much trends over time. Age and sex adjusted rates were also very similar to unadjusted rates (Table 3).

The sensitivity analysis where we excluded patients who initiated dialysis before January 1999 led to similar results (data not shown). Trends between hemodialysis and peritoneal patients were similar (data not shown).

Interpretation

This study describes in a large cohort of Canadian chronic dialysis patients trends of IRH and impact of dialysis vintage. We found stable rates of IRH, but decreasing rates of all-cause and cardiovascular hospitalizations over time. Therefore, hospitalization's burden attributable to infection increased over the years. Similarly, we found decreasing rates of all-cause and cardiovascular hospitalizations with dialysis vintage, but not with IRH. While we found interaction between calendar time and dialysis vintage for all-cause and cardiovascular

hospitalizations, trends of dialysis-vintage adjusted hospitalization rates were very similar to unadjusted rates.

All-cause and IRH rates among patients on dialysis have not been studied in Canada. The USRDS annual report showed slightly decreasing all-cause hospitalization rates trends: from 1.97 to 1.90 /p-y between 2001 and 2007.[1] Those rates are higher than what we are reporting, but comparisons should be use with caution because of case-mix differences between populations, as dialysis populations significantly differ between countries.[1,8,17] Infection-related and cardiovascular hospitalizations were also higher in the US at 0.46 /p-y and 0.56 /p-y, respectively, for hemodialysis patients on 2007.[1] Both rates were relatively stable between 2001 and 2007.[1]

Why IRH are not decreasing between 2001 and 2007 remains unclear, and should be the focus of further studies. It may be explained by increasing prevalence of diabetes in the chronic dialysis population. Furthermore, despite that vascular access-related bloodstream infections are recognized as a major cause of infections in the dialysis population and that catheter use (instead of arteriovenous shunts) is the principal risk factor for those infections, proportion of catheter use increased from 76.8% to 82.6% among incident hemodialysis patients in Canada between 2001 and 2009.[8,10,18] Other reported risk factors for IRH are: older age,[19-21] female sex,[21] black race,[19,20] no insurance,[19] smoking,[22] diabetes,[5,19-21,23] high co-morbidity score,[5] heart failure,[21] pulmonary disease,[21] lower serum albumin,[5,19-21] decreased hematocrit levels,[24] higher use of erythropoietin,[24] and corticosteroid use.[22]

Decreasing trends in all-cause hospitalizations over calendar time may be explained by the fact that some interventions, such as vascular access or cardiovascular procedures, which used to be done in an inpatient setting, are now done in an outpatient setting. Decreasing trends in

cardiovascular hospitalizations may be due to more aggressive treatment of cardiovascular risk factors such as hyperlipidemia and hypertension.

Very few studies evaluated hospitalization incidence through dialysis vintages. USRDS annual reports suggests that hospitalization rates are higher in the first year of dialysis.[1] Another study showed that above 50% of patients initiating dialysis are hospitalized in the first 100 days.[2] Our results add to those reports by showing that while rates mostly decrease after the first year, they continue to decrease for at least the first four years after initiation of dialysis. The first year of dialysis is believed to be at greater risk of morbidity and mortality than subsequent years.[1] This may due to higher use of catheter in that period or dialysis prescription adjustment.[18] This phenomenon may also be explained by a survival effect. Patients with severe concurrent conditions will die early while patients remaining after a few years may be healthier. Because patients with high co-morbidities are hospitalized more often, rates of hospitalizations would be higher in the first years when those patients are still in the cohort.

Our study has several strengths. First, we were able to follow patients in their first 90 days after dialysis initiation. This high-risk period is often excluded from studies because hospitalizations are not covered in other datasets. Second, a universal health care setting allowed inclusion of all chronic dialysis patients in the province with minimal selection bias.

As most retrospective studies, our study has several limitations. First, because we relied on claims and ICD-9 codes to identify dialysis patients, we may have missed some patients on chronic dialysis. However, validity of identifying dialysis patients through procedure billing claims in the RAMQ is thought to be high, since multiple treatments are performed. Unfortunately, we had no access to data before 1999. However, excluding patients who initiated dialysis before that date yielded similar results. Because of prohibitive numbers of strata, we are not able to adjust for age and sex in addition to dialysis vintage. Adjustment using a multivariate

model would be an alternative to overcome this issue, but would only give an estimate of the trend and not actual rates, which are a lot easier to interpret clinically. Nevertheless, age distribution and sex proportion did not change significantly during the observed period. In addition, age-sex adjusted rates were almost identical to unadjusted rates, which confirms previous findings where hospitalization rates were similar between elderly and younger patients on hemodialysis.[1,25] While many factors may change over time and with dialysis vintage, the goal of this analysis was to evaluate the resulting effect on IRH of those changes occurring with dialysis vintage. Adjusting for intermediate factors such as co-morbidities could take away the effect from dialysis vintage. Further studies are needed to investigate mechanisms or explaining factors between dialysis vintage and IRH rates.

In summary, we found a decreasing trend of all-cause and cardiovascular hospitalization rates among patients on chronic dialysis, independently of age and sex, or dialysis vintage. Differently, trend of IRH remained stable over time, leading to an increase of the proportion of admissions related to infections from 13 to 16% of all admissions. While both all-cause and cardiovascular hospitalizations rates decreased with dialysis vintage, IRH rates remained stable. Understanding epidemiology of IRH among patients receiving chronic dialysis may inform future studies on prevention of this common and serious outcome.

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Disclosure

None to declare.

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Table 1. Baseline characteristics.

Baseline characteristics	N=9822
Age (years)	66.3±14.7
Female sex (%)	40
Dialysis modality* (%)	
Hemodialysis	81
Peritoneal dialysis	19
Hospitalization in prior year (%)	
0	47
1	27
≥2	26
Co-morbidities (%)	
Cardiovascular disease	41
Cerebrovascular disease	7
Chronic pulmonary disease	17
Congestive heart failure	25
Diabetes	45
Malignancy	13
Peripheral vascular disease	24

* Dialysis modality was assigned at cohort entry and was not updated through time.

Table 2. Overall hospitalization rates by cause.

	N	Rate (/person-year)	95% CI
All causes	35246	1.352	1.338 , 1.366
Cardiovascular	9240	0.354	0.347 , 0.362
Infection	5209	0.200	0.194 , 0.205
Dialysis-related	1196	0.046	0.043 , 0.049
Pneumonia	734	0.028	0.026 , 0.030
Septicemia	578	0.022	0.020 , 0.024
Other infection	2701	0.104	0.100 , 0.108
Other	20797	0.798	0.787 , 0.809

Abbreviation: CI, confidence interval.

Table 3. Hospitalization rates (per person-year) by calendar year, standardized by age-sex, and dialysis vintage.

Year	N	All causes			Infection			Cardiovascular		
		Crude	Age-sex*	Vintage†	Crude	Age-sex	Vintage	Crude	Age-sex	Vintage
2001	4232	1.53	1.54	1.52	0.20	0.20	0.20	0.45	0.45	0.45
2002	4383	1.42	1.42	1.41	0.20	0.20	0.20	0.41	0.41	0.40
2003	4492	1.38	1.38	1.38	0.19	0.19	0.19	0.38	0.38	0.38
2004	4570	1.38	1.38	1.39	0.21	0.21	0.21	0.39	0.39	0.39
2005	4753	1.32	1.32	1.32	0.21	0.21	0.21	0.35	0.35	0.35
2006	4921	1.29	1.30	1.31	0.20	0.20	0.20	0.29	0.29	0.29
2007	4822	1.18	1.18	1.19	0.19	0.19	0.19	0.24	0.24	0.24
P trend		<0.001			0.7			<0.001		

* Adjusted for age and sex considering the whole cohort distribution as the reference population.

† Adjusted for dialysis vintage considering the whole cohort distribution as the reference population.

Legends to Figures

Figure 1. Derivation of cohort. Excluded patients with less than 3 months of follow-up represent patients who died or reached end of study period before 90 days.

Figure 2. Unadjusted admission rates by calendar years.

Figure 3. Unadjusted admission rates by dialysis vintage.

Figure 4. Hazard function for all-cause and cause-specific admissions using recurrent hospitalizations (counting-process Cox regression model).

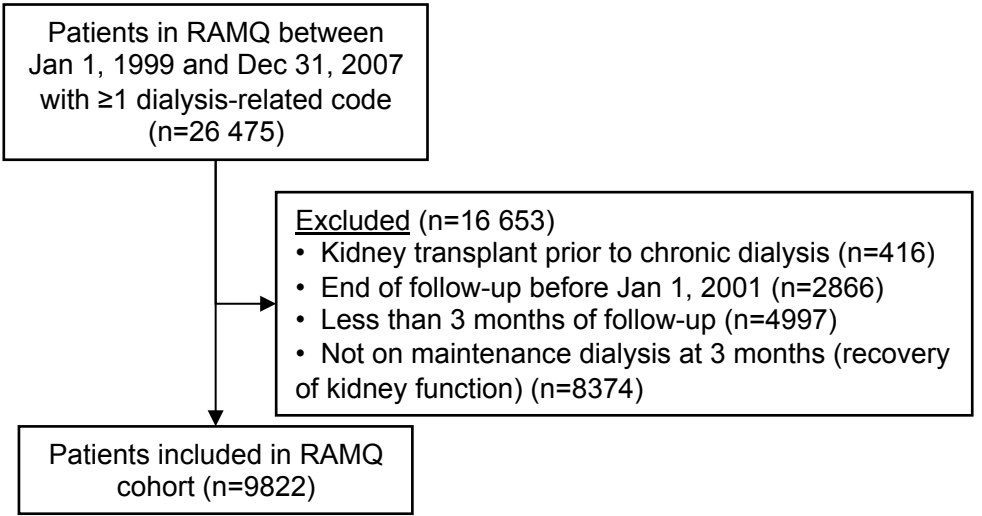
Supplementary Material

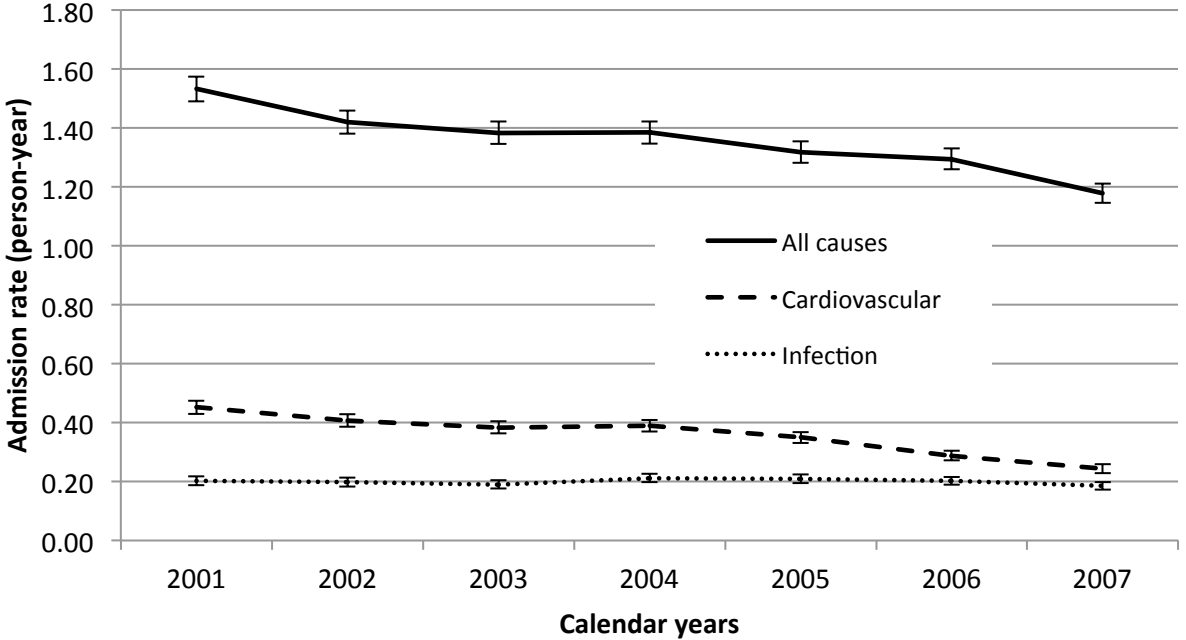
Table S1. ICD-9 and ICD-10 codes for infection-related and cardiovascular hospitalizations.

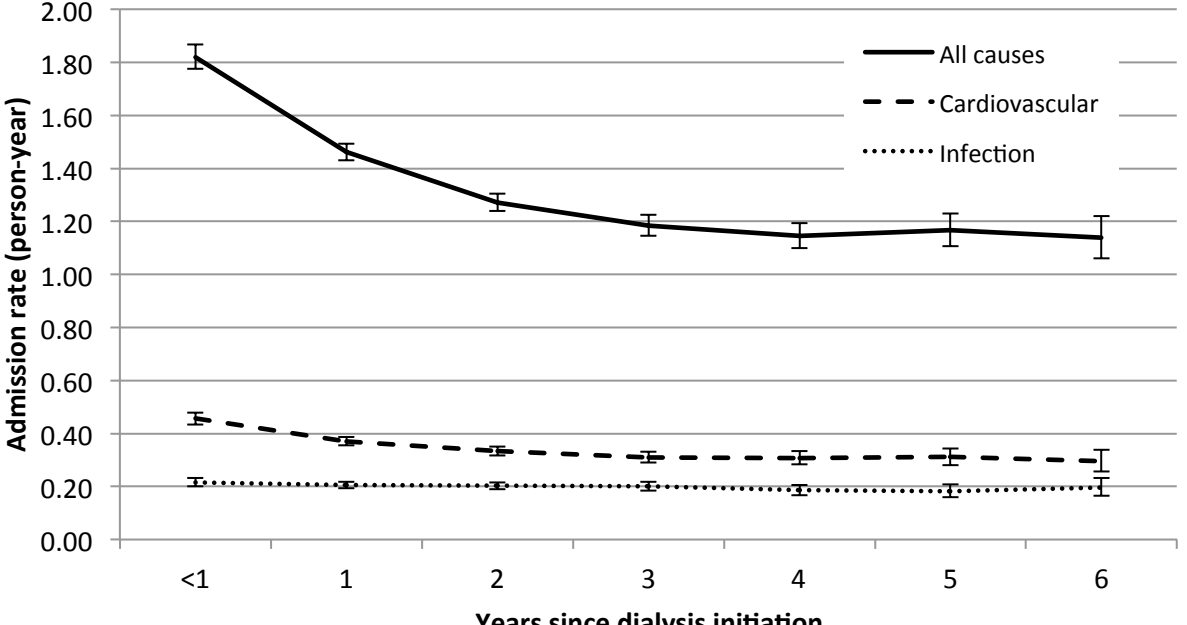
Definition	ICD-9 codes	ICD-10 codes
Cardiovascular	276.6, 336.1, 362.3, 393-398, 401-405, 410-417, 420, 421.9, 422.90, 422.99, 423-438, 440-448, 451-459, 557, 785.0-785.4, 785.51	E87.7, G45-G46, G95.1, H34, I05- I15, I20-I28, I30.0, I30.8-I30.9, I31, I32.8, I33.9, I34-I39, I40.1, I40.8-I40.9, I41.8, I42, I43.1, I43.2, I43.9, I44-I51, I52.8, I60-I87, I89, I95-I96, I98.2, I98.8, I99, K55, M30-M31, R00-R02, R57.0, R58
Infection (all)	001-134, 136, 139, 254.1, 320-326, 331.81, 362, 372.0-372.3, 373.0-373.2, 382, 383.0, 386.33, 386.35, 388.60, 390-392, 421.0,421.1, 422.0, 422.91-422.93, 449, 460-466, 472-473, 474.0, 475, 476.0-476.1, 478.21-478.22, 478.24, 478.29, 480-488, 490, 491.1, 494, 510, 511.0-511.1, 513, 518.6, 519.01, 519.2,522.5, 522.7, 527.3, 528.3, 540-542, 562.01, 562.03, 562.10, 562.13, 566-567, 569.5, 572.0-572.1, 573.1-573.3, 575.0-575.1, 590, 595.0-595.4, 597, 598.0, 599.0, 601, 603.1, 604, 607.1-607.2, 608.0, 608.4, 611.0, 614-615, 616.0-616.1, 616.3-616.4, 616.8, 639.0, 646.6, 647, 670, 675, 680-686, 695.81, 706.0, 711, 727.89, 728.0, 730.0-730.3, 730.8-730.9, 780.60, 785.52, 790.7-790.8, 958.3, 996.6, 997.62, 998.5, 999.3	A00-A32, A34-A99, B00-B89, B95-B97, B99, D73.3, E32.1, G00-G02, G04.0, G04.2, G05-G09, G53.1, G63.0, G73.4, G93.7, G94.0, H00, H01.0, H03, H05.0, H06.1, H10.0, H10.2-H10.5, H10.8 -H10.9, H13.0-H13.2, H19.0-H19.2, H22.0, H32.0, H44.0, H60, H62.0-H62.4, H66, H67.0-H67.1, H70.0, H75.0, H83.0, H92.1, H94.0, I00-I02, I30.1, I32.0-I32.1, I33.0, I39, I40.0, I41.0-I41.2, I43.0, I52.0- I52.1, I68.1, I79, I98.0-I98.2, I98.8, J00-J06, J09-J22, J31-J32, J34.0, J35.0, J36-J37, J39.0-J39.1, J40, J41.1, J44.0, J47, J65, J85-J86, K04.6-K04.7, K11.3, K12.2, K23.0, K35-K37, K57.0, K57.2, K57.4, K57.8, K61, K63.0, K65.0, K65.9, K67, K75.0, K77.0, K81, L00-L08, L30.3, L70.2, M00-M01, M03, M46.2-M46.5, M49.0-M49.3, M60.0, M63.0-M63.2, M65.0-M65.1, M68.0, M71.0-M71.1, M86, M90.0-M90.2, N08.0, N10, N11.0-N11.1, N11.8, N12, N13.6, N15.1, N16.0, N29.0-N29.1, N30.0-N30.3, N33-N34, N35.1, N39.0, N41, N43.1, N45, N48.1-N48.2, N49, N51, N61, N70-N74, N75.1, N76.0-N76.4, N77.0-N77.1, N98.0, O03.0, O03.5, O04.0, O04.5, O05.0, O05.5, O08.0, O23, O85, O86, O91, O98, R00, R01, R02, R50.8, R50.9, R57.2, T79.3, T80.2, T81.4, T82.6, T82.7, T83.5-T83.6, T84.5-T84.7, T85.7, T87.4, T88.0
Dialysis-related	567, 996.62, 996.68, 996.69	T82.7, T85.7, K65.0, K65.9
Pneumonia	480-486, 487.0	J12-J18, J10.0, J11.0, J85.1
Septicemia	003.1, 022.3, 036.2, 038, 054.5, 112.5, 790.7, 785.52	A40 -A41, O85, A02.1, A22.7, A26.7, A32.7, A39.2, A39.3-A39.4, A42.7, B37.7, R57.2

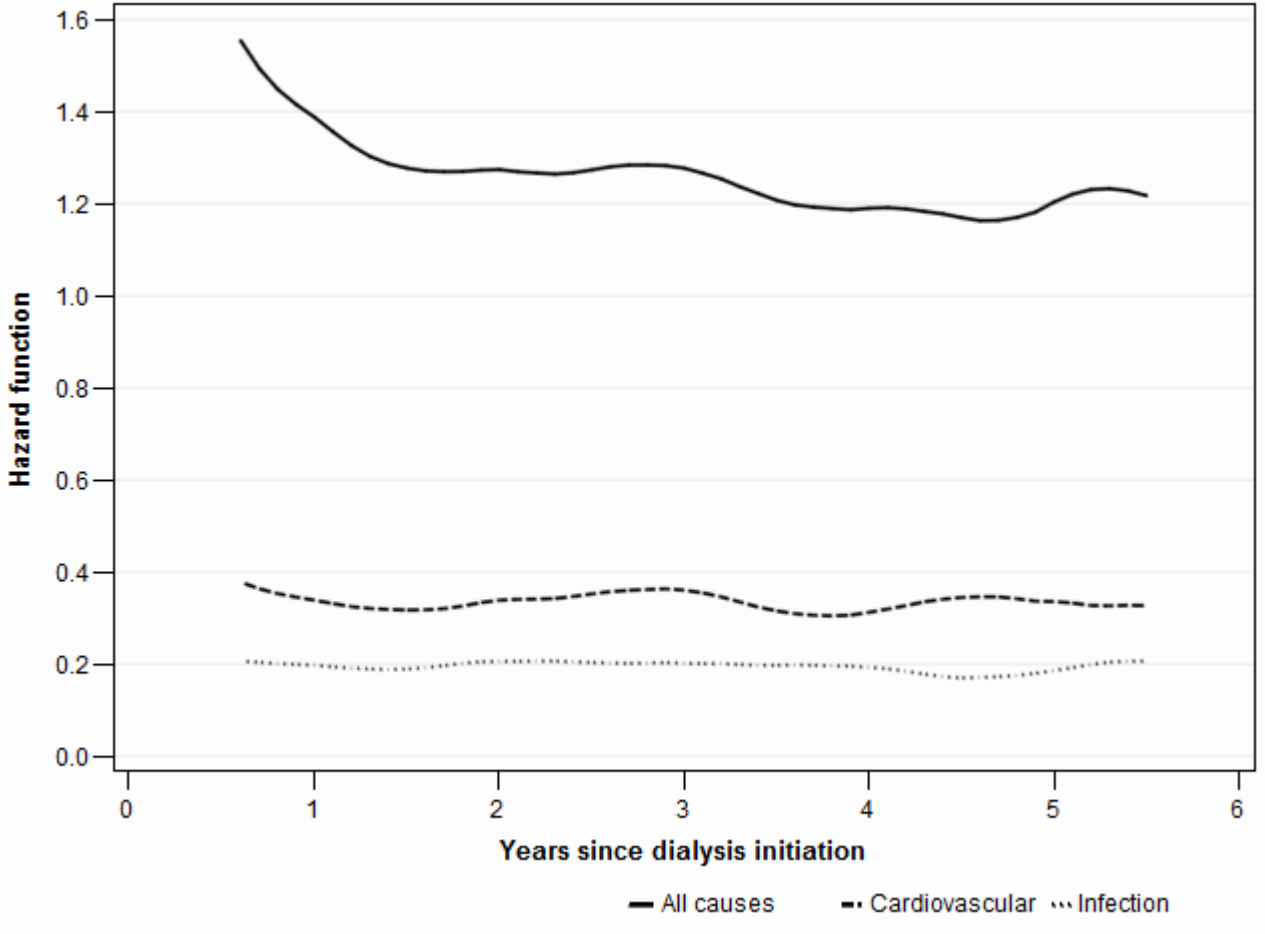
Table S2. ICD-9 and ICD-10 codes for assessment of comorbidities.

Definition	ICD-9 codes	ICD-10 codes
Cardiovascular disease	410, 411 (except 411.0), 412, 413.0, 413.9, 414 (except 414.1)	I21, I24 (except I24.1), I25, I20.0, I20.9, I25 (except I25.3 and I25.4)
Cerebrovascular disease	430-432, 434, 436, 438, (342, 433, 435, or 438) and V57, 433 and 342, 435	I60-I62, I64, I66, I69, I73, G45, I63.3-I63.9, G45, G46.0, G46.6, G46.7, (I65, I63.0-I63.2, or I66.3) and Z50, (I65, I63.0-I63.2, or I66.3) and G81, G81 and Z50
Congestive heart failure	428, 402.01, 402.11, 402.91, 404.01, 404.11, 404.91, 404.03, 404.13, 404.93	I50
Chronic pulmonary disease	492, 493, 496	J43, J44, J45
Diabetes	250, 357.2, 362.0, 366.41	E10 -E14, G63.2, H36.0, H28.0
Malignancy	140-209 (except 173)	C00 -C97 (except C44, C46)
Peripheral vascular disease	250.7, 440.2-440.3, 440.8-440.9, 443, 785.4	E10.5, E11.5, E13.5, E14.5, I70.2, I70.8-I70.9, I73, R02


Patients in RAMQ between Jan 1, 1999 and Dec 31, 2007 with ≥1 dialysis-related code (n=26 475)
Excluded (n=16 653)
• Kidney transplant prior to chronic dialysis (n=416)
• End of follow-up before Jan 1, 2001 (n=2866)
• Less than 3 months of follow-up (n=4997)
• Not on maintenance dialysis at 3 months (recovery of kidney function) (n=8374)
Patients included in RAMQ cohort (n=9822)


1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Admission rate (person-year)
All causes
Cardiovascular
Infection
2001
2002
2003
2004
2005
2006
2007
Calendar years


2.00
1.80
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Admission rate (person-year)
All causes
Cardiovascular
Infection
<1
1
2
3
4
5
6
Years since dialysis initiation


1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Hazard function
0
1
2
3
4
5
6
Years since dialysis initiation
All causes
Cardiovascular
Infection